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Determining Insurance Companies' Product Portfolio through Using Multi Criteria Decision Making techniques: A Case Study in Mellat Insurance Company

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Abstract

Since the creation of man, the risk has been associated with humans and humans in a way to get rid of these risks. Insurance has a major role in offsetting the financial impact for the people. The concern of organizations' senior managers with several different products is using of appropriate models for portfolio management and for determining of combined production of profitable products. There is not any exception for insurance companies. In this paper, by using multi-criteria decision making methods, we have suggested models for ranking different insurance products and determining the product portfolio of insurance companies. Using Analytical Hierarchy Process, Analytic Network Process, TOPSIS and combination of these methods, moreover considering criteria consist of the share of the portfolio, market share, loss coefficient and market growth rate, the Mellat insurance company's product portfolio has been determined. In addition, the best production portfolio for the insurance company has been proposed using Borda method.

Keywords: insurance, insurance production portfolio, multi-attribute decision making, Analytic Hierarchy Process, Analytic Network Process, TOPSIS, Borda method

Introduction

Insurance is a contract to compensate for damages caused by accidents, between natural or legal person and is a composed and organized group. Under this contract, one party (the insurer) by organizing a group (insurance) in an organization called the Institute of Insurance commits in exchange for fund or funds that the insured pays to this organization in the event of a specified accident for each of them to make up for the damage or pay a certain fund.

Insurance not only transfer risk but is also an appropriate and important tool for saving and thereby it contribute significantly to economic development. Insurance portfolio indicates the share of each of the obligations of the insurance in the insurer's field. By evaluating insurance portfolio it can be shown that which subjects are of most interest to our customers and what subjects are not considered. Identifying these criteria will help insurance companies to select the right mix for their products portfolio. Among the concerns of managers with many different products, such as insurance companies, is using appropriate models for portfolio management and determining the profitable production mixture of the organization's products. So far, several studies have provided models for determining insurance companies' portfolio. Kahane and Nee in 1975 have offered a model for determining insurance companies portfolio (Kahane & Nye, 1975).In this paper, the proposed model for determining the business policy and marketing decisions has been used. For this purpose, eighteen lines of insurance and two assets (stocks and bonds) were analyzed. Author offered a method to determine simultaneously the composition of the insurance policies portfolio and the investment portfolio in which it is assumed that the company tries to minimize variance of return on assets (risk) for the different levels of profitability (expected return). The proposed method is more dependent on past data than management predictions about the future. In this model, the limitations that affect marketing relations have been used and the possibility of market saturation

has also been considered. In 2002, Mahmoudian investigated the direct and indirect impact on the performance of the sales strategies of insurance companies on the functions of these companies by considering the risk characteristics of the portfolio, Utility Criteria of portfolio composition and appropriate portfolio index. In 2002, Parkhan Razlieqy studied the effect of the optimal strategy for production companies operating in the insurance industry using TOPSIS3 method. The quantity Indices considered include the portfolio risk, the loss ratio, the share of market and share of the subject from total (share in the total portfolio) and quality indicators include workers behaviors, the amount of information provision, speed of delivering service, skill and ability of staff. In the same year, Nasirinia (2003) investigated the factors affecting the portfolios of the represenetives of Iran insurance company. In this study, an important criterion for the sale of insurance products is discussed. The proposed indicators include: the potential market growth Variable, market profitability, the cost of obtaining the market, market share, customer satisfaction, market stability and competitive position in the market. Azar et.al (2010) identified and prioritized effective measures in managing Parsian Company's product portfolio using TOPSIS and AHP (AHP) methods. The results show that after the passengers and third party insurance, fire insurance as the most attractive service insurance and after it life insurance the policy has been the focus of the organization's activities and policies. In this study, an effort has been made to use multi-criteria decision making techniques to identify product portfolio of Mellat insurance. Then, in Section 2, the multi-criteria decision-making methods including TOPSIS ،AHP و ANP[1] have been introduced. In section 3, multi-criteria decision-making models have been examined and implemented to identify the Mellat insurance company's product portfolio. In Section 4, conclusions and recommendations are presented.

Multiple Criteria Decision Making Methods of AHP, ANP and TOPSIS

Given that, in this study by using AHP, ANP and TOPSIS methods, it's offered models to determine policies portfolio of insurance companies, in this section, these methods are briefly introduced. Also, Breda's method which is used to combine the results is introduced.

Analytic Hierarchy Process (AHP)

Analytic Hierarchy Process, is a method of multiple criteria decision making that is used in order to decide and choose an option from multiple options of decision making according to the criteria that are determined by the decision-maker. This method was invented and presented in 1980 by Thomas Hour. AHP reflects the human normal behavior and thought. This technique, studies the complex issues based on their interactions and changes them simply, and solves them. Using this method needs to the following four major steps (Mehregan, 2004):

Modeling: In this step, the purpose of decision-making is achieved of associated decision-making elements together, hierarchically. Decision-making elements include indexes of decision making and decision options. The first level represents the main objectives of the decision-making process. The second represents the major indexes (which may be divided in more detailed subsidiary, in the next level) and the third will provides decision options.

Preferential judgment: Paired comparisons between the various decision options are done based on any given index as well as indexes of decision making.

The calculation of the relative weights: the ratios of weight and importance of decision options is determined through a series of numerical calculations. First, it calculates the sum of numbers in each column of matrix of paired comparisons, then each column element is divided by the sum of numbers in that column. The new matrix obtained in this way, is called normalized

[1] Analytic Network Process

comparisons matrix. So average number of each row of the matrix is obtained. The average represents relative weight of the decision options corresponding to rows of matrix.

Integration of relative weights: this step is carried out in order to ranking decision options. In this step, matrix of weight of indexes for each decision option is multiplied by vector of the weight of indexes.

Examination of Compatibility of judgments: Experience has shown that if the compatibizlity is less than 1.0 then the Compatibility of comparison is acceptable, otherwise it must be done again. The following steps should be taken for calculating the ratio of compatibility:

• To calculate the total weight vector: matrix of paired comparisons is multiplied by the column vector of relative weights. This vector is called the weighted sum vector.

• To calculate the compatibility vector: elements of weighted sum vector are divided in the relative priority vector. The resulting vector is called a compatibility vector.

• To obtain λ_{max}: The average of elements of the compatibility vector is calculated.

• To calculate the index of compatibility: index of compatibility is calculated as follows:

$$CI = \frac{\lambda_{\max} - n}{n-1} \quad (1)$$

n is the number of options in issue.

• To calculate the ratio of compatibility: ratio of compatibility is obtained by dividing the compatibility index in random index.

$$CR = \frac{CI}{RI} \quad (2)$$

The random index is derived from the following table.

Table 1: Random index

N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0	0	.58	.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

Analytic Network Process (ANP)

The analytic network process is one of the techniques of multiple criteria decision making that presented by Hour in order to provide a solution for multiple- criteria decision making problems that have mutual relations and correlations between decision-making levels (goal, criteria of decision and sub-criteria of its, the decision options) .The analytic network process is a expansion of analytic hierarchy process method.

Technique of AHP can consider by a comprehensive framework, all the interactions and relations between the decision-making levels that constitute a network structure (Azar & Rajabzadeh, 2003). The direction of arcs represents the dependence and loops also show the interdependence of each elements of each cluster.

The ANP technique is used to determine the relative importance of the criteria and priorities of the option of decision making issue of super matrix. In fact, a super matrix is a partitioned matrix that shows the relationship between two nodes (the decision level) in each part of the matrix. Standard form of a super matrix introduced by Hour in 1996, can been shown in Figure 1 that C represents nodes and e represents the elements in the nodes. Vectors of W into the matrix are weight vectors resulted of paired comparison of elements of nodes together (Momeni & Sharifi Salim,2012).

All the relationships and interactions between the levels of decision-making are evaluated by the paired comparisons in method of super matrix. But, by the entering the paired comparisons done

between elements of decision-making levels in super matrixes, most of the sum of columns is greater than 1 that it is called non-weight super matrix. By multiplying the weight of each of the clusters by the corresponding elements, weight super matrix is obtained. Finally, to achieve to the total weight of problem options and criteria of decision making and solving the problem, bordered super matrix must be calculated. By using a probability matrixes and Markov's chain, Hour proves total weight of the elements is obtained from the following equation:

$$\mathrm{W} = \lim_{k\to\infty} W^{2k+1} \tag{3}$$

		C_1				C_2				…	C_N			
		e_{11}	e_{12}	…	e_{1n_1}	e_{11}	e_{11}	…	e_{1n_1}		e_{11}	e_{11}	…	e_{1n_1}
C_1	e_{11} e_{11} e_{1n_1}	W_{11}				W_{12}				…	W_{1N}			
C_2	e_{11} e_{11} e_{1n_1}	W_{21}				W_{22}				…	W_{2N}			
⋮		…				…				…	…			
C_N	e_{11} e_{11} e_{1n_1}	W_{N1}				W_{N2}				…	W_{NN}			

Figure 1: Super matrix in ANP

TOPSIS method

This method was represented in 1981 by Huang Yun. In this method can be assessed m options by n indexes options and any problem can be considered as a geometric system with m points in an n-dimensional space. This technique is based on the concept that selected option should have minimum distance from the positive ideal solution (the best possible, A_i^+), and the maximum distance from the negative ideal solution (worst possible, A_i^-). Solving a problem by TOPSIS method including 6 Steps is as follows (Azar & Rajabzadeh, 2003):

1. The available decision matrix is normalized.

$$n_{ij} = \frac{r_{ij}}{\sqrt{\sum_{i=1}^{m} r_{ij}^{\,2}}} \tag{4}$$

The resulting matrix is called N_D.

2. The weighted normalized matrix is calculated.

$$V = N_D \times W_{n\times n} \tag{5}$$

Where V is the weighted normalized matrix and W is a diagonal matrix of weights obtained for the indexes.

3. The positive ideal solution (A_i^+) and negative ideal solution (A_i^-) are specified.

$$A^+ = \left\{ V_1^+, V_2^+, ..., V_n^+ \right\} = \left\{ \left(\max_i V_{ij} \middle| j \in J_1 \right), \left(\min_i V_{ij} \middle| j \in J_2 \right) \middle| i = 1,2,..., m \right\} \quad (6)$$

$$A^- = \left\{ V_1^-, V_2^-, ..., V_n^- \right\} = \left\{ \left(\min_i V_{ij} \middle| j \in J_1 \right), \left(\max_i V_{ij} \middle| j \in J_2 \right) \middle| i = 1,2,..., m \right\} \quad (7)$$

J_1 is set of benefit and J_2 is set of cost indexes.

4. Distance of each option to positive and negative ideal solution is calculated.

$$\sqrt{\sum_{j=1}^{n} (V_{ij} - V_j^+)^2} \qquad ,(i = 1,2,..., m) \quad (8)$$

$$d_i^- = \sqrt{\sum_{j=1}^{n} (V_{ij} - V_j^-)^2} \qquad ,(i = 1,2,..., m) \quad (9)$$

5. The relative closeness A_i to the ideal solution is calculated as follows:

$$C_i = \frac{d_i^-}{d_i^+ + d_i^-} \qquad ,(i = 1,2,..., m) \quad (10)$$

6. Ranking the options is done at this stage and available options can been ranked based on the most important options based on the descending order C_i .

Borda method

If several methods are used for multiple criteria decision making problems, by using Breda method, the results can be combined. In this way, the number of wins and losses are determined for each criterion. To implement this technique, a non-diagonal matrix $m \times m$ is formed. If the number of wins is more in techniques, it's coded by M and row i is preferred to column j and if the column j has been preferred to row i or the number of wins been equal coded by X. Finally, sum of wins i placed in each row is base of ranking. Whatever the number of wins is greater, the ranking is higher.

Implementation of multi-attribute decision-making models to determine the policies portfolio in Mellat insurance company

In this section, four multi-attribute decision-making models are carried out to determine the policies portfolio of Mellat insurance company that is the largest private insurance company in the insurance industry in Iran. The details of implemented models as below:

Implementation of AHP model to determine the Mellat insurance company's policies portfolio

Modeling

As mentioned earlier in this step, here due of the purpose of the issue the Mellat insurance company's policies portfolio was selected and the indexes has been considered and various options including various insurance are compared. Figure 2 shows the AHP decision making model for choosing the policies portfolio.

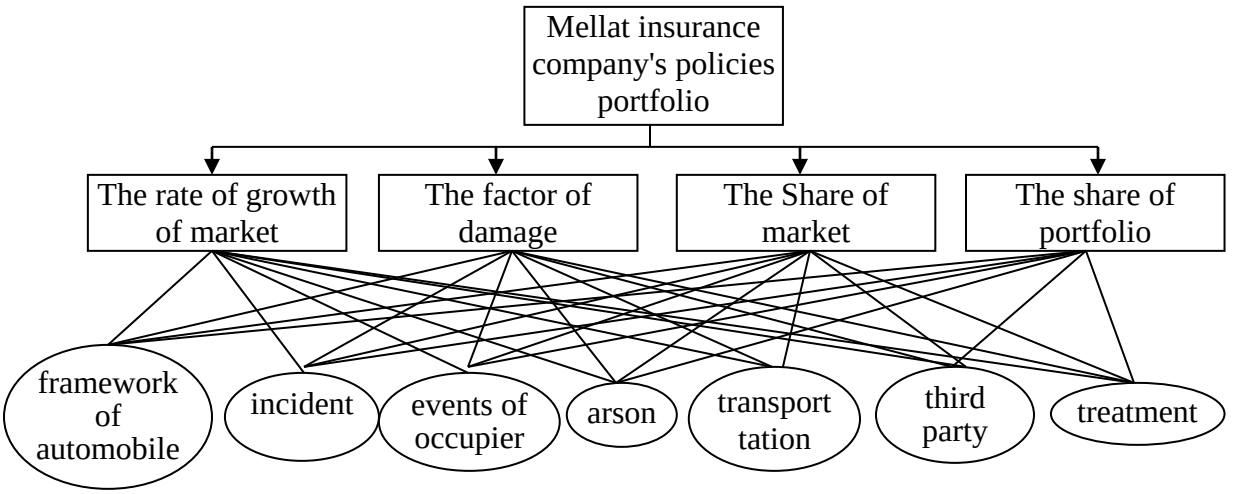

Figure 2: AHP decision making model for the Mellat insurance company's policies portfolio

As you can see, seven the insurance , Transportation, Arson, Framework of automobile, Incident, Third party, Events of occupier and treatment are examined by four indicators that are:

1. The share of portfolio: It's a percentage that each field in the portfolio of Mellat insurance company is allocated itself.

2. The Share of market: This index is provided by division the amount of sales in total sales of available companies, in the insurance industry.

3. The factor of damage: It is a percentage of loss that is related to premiums of performance of the same year that these damages are occurred in. In simpler terms, this index shows the ratio of paid damaged to the received premiums.

4. The rate of growth of market: It shows the rate of the annual growth of a market that has these products.

Table 2: Weight of indexes

Indexes	The share of portfolio	The Share of market	The factor of damage	The rate of growth
weight	.2834	.2660	.2196	.2310

Table 3: Weight of products of insurance based on indexes

Indexes					
The share of portfolio	The Share of market	The factor of damage	The rate of growth		
.1656	.1805	.1138	.1480	framework of automobile	Products of insurance
.1434	.1657	.1033	.1430	incident	
.1187	.0950	.1261	.1252	events of occupier	
.2081	.2149	.1073	.1991	arson	
.2020	.2086	.1364	.1926	transportation	
.1164	.959	.2066	.1211	third party	
.0458	.394	.2066	.0711	treatment	

Preferential judgment

At this step, paired comparisons between various indexes as well as between the different products of the insurance based on the each index, are conducted by experts.

The calculations of relative weights

At this step, after the composition of expert's ideas by using the geometric tools, the relative weights of index and weights of various models based on the parameters shown in Table (2) and (3) is obtained.

Integration of relative weight

At this step, weights of indexes matrix for each product of the insurance are multiplied by the vector of weight of indexes and ranking of the various products of the insurance is done according to table (4).

Table 4: Ranking of the various products of the insurance by using the AHP method

Rank	Score	Product of the insurance
3	.1519	Framework of automobile
4	.1389	Incident
6	.1170	Events of occupier
2	.1837	Arson
1	.1856	Transportation
5	.1341	Third party
7	0/0887	Treatment

Compatibility judgment

At this step, the various compatibility matrix of decision has been reviewed and approved. Thus, in accordance with AHP, respectively, transportation, arson, framework of automobile, third party, events of occupier and treatment insurance are in Mellat insurance company's policies portfolio.

Implementation of ANP model to determine the Mellat insurance company's policies portfolio

Figure 3 shows ANP model to choose the policies portfolio. As can be seen in this model also the interaction between the various indexes is considered. Table 5 shows weightless super matrix including relative priorities of paired comparisons in the network and table (6) shows Integration super matrixes.

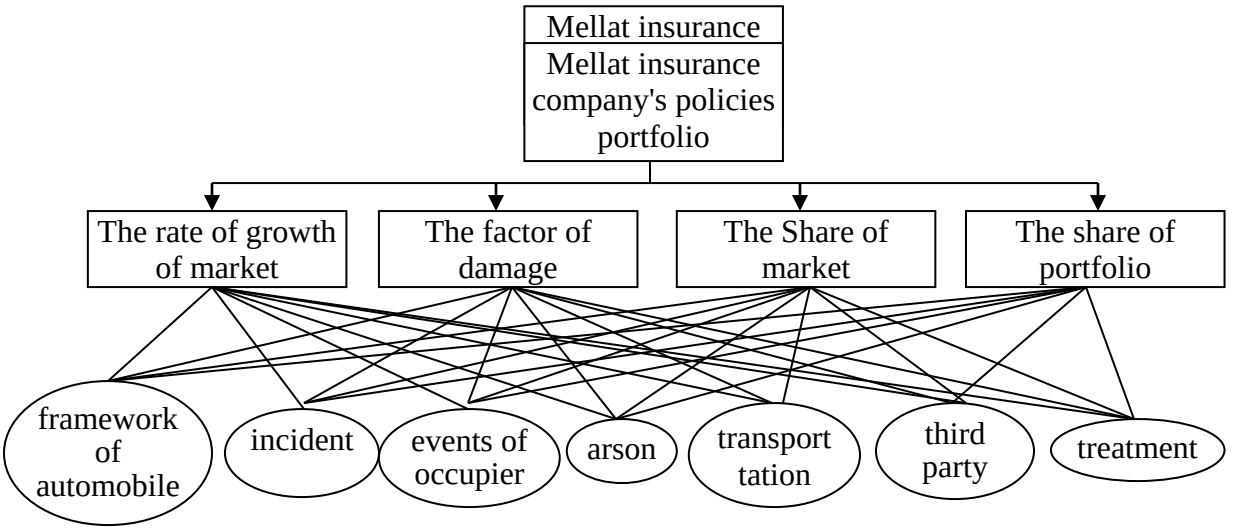

Figure 3: AHP decision making model for the Mellat insurance company's policies portfolio

Table 5: Non-weighted super matrix including relative priorities of paired comparisons Network

The rate of growth of market	The factor of damage	The share of portfolio	The Share of market	third party	treatment	Events of occupier	incident	Framework of automobile	transportation	arson	
.1989	.1073	.2073	.2141	0	0	0	0	0	0	0	Arson
.1924	.1363	.2013	.2079	0	0	0	0	0	0	0	Transportation
.1487	.1142	.1687	.1791	0	0	0	0	0	0	0	Framework of automobile
.1428	.1032	.1429	.1555	0	0	0	0	0	0	0	incident
.1251	.1260	.1182	.0986	0	0	0	0	0	0	0	events of occupier
.0711	.2065	.0457	.0430	0	0	0	0	0	0	0	treatment
.1210	.2065	.1160	.1017	0	0	0	0	0	0	0	events of occupier
0	0	0	0	.1553	.1108	.2076	.8266	.1999	.2574	.2547	The Share of market
0	0	0	0	.2485	.1108	.2652	.0247	.2612	.2574	.2737	The share of portfolio
0	0	0	0	.2861	.3640	.2427	.2210	.2527	.2118	.1965	The factor of damage
0	0	0	0	.3101	.4144	.2846	.0276	.2821	.2733	.2750	The rate of growth of market

Table 6: Converged super matrix

The rate of growth of market	The factor of damage	The share of portfolio	The Share of market	third party	treatment	events of occupier	incident	framework of automobile	transportation	arson	
.0910	.0910	.0910	.0910	0	0	0	0	0	0	0	arson
.0921	.0921	.0921	.0921	0	0	0	0	0	0	0	transportation
.0760	.0760	.0760	.0760	0	0	0	0	0	0	0	framework of automobile
.0680	.0680	.0680	.0680	0	0	0	0	0	0	0	incident
.0590	.0590	.0590	.0590	0	0	0	0	0	0	0	events of occupier
.0458	.0458	.0458	.0458	0	0	0	0	0	0	0	treatment
.0590	.0590	.0590	.0590	0	0	0	0	0	0	0	events of occupier
0	0	0	0	.1081	.1081	.1081	.1081	.1081	.1081	.1081	The Share of market
0	0	0	0	.1229	.1229	.1229	.1229	.1229	.1229	.1229	The share of portfolio
0	0	0	0	.1217	.1217	.1217	.1217	.1217	.1217	.1217	The factor of damage
0	0	0	0	.1473	.1473	.1473	.1473	.1473	.1473	.1473	The rate of growth of market

Thus, in accordance with ANP, respectively, transportation, arson, framework of automobile, third party, events of occupier and treatment insurance are in Mellat insurance company's policies portfolio.

Implementation of AHP-TOPSIS model to determine the Mellat insurance company's policies portfolio

In this method, weight of indexes is determined by using the AHP method in accordance with the table (2) and then the priority of various insurance products is specified by using TOPSIS method. Relative closeness of each option to the ideal solution and ranking of various insurance products is shown by using the method shown in Table 7.

Table 7: Ranking of insurance products by using the AHP-TOPSIS method

Rank	Ci	Product of the insurance
2	.4620	Framework of automobile
6	.1791	Incident
3	.2975	Events of occupier
7	.1286	Arson
5	.2350	Transportation
1	.6573	Third party
4	.2919	Treatment

So, in accordance with the AHP-TOPSIS, respectively, third party, framework of automobile and events of occupier, treatment, transportation, incident and arson insurance are placed in the policies portfolio of the Mellat insurance company.

Implementation of AHP-TOPSIS model to determine the Mellat insurance company's policies portfolio

In this method, weight of indexes is determined by using the ANP method in accordance with the table (6) and then the priority of various insurance products is specified by using TOPSIS method. Relative closeness of each option to the ideal solution and ranking of various insurance products is shown by using the method shown in Table 8.

So, in accordance with ANP-TOPSIS, respectively third party, framework of automobile and treatment insurance and then events of occupier, transportation, incident, arson insurance are placed in the policies portfolio of the Mellat insurance company

Table 8: Ranking of insurance products by using the ANP-TOPSIS method

Rank	Ci	Product of the insurance
2	.4778	Framework of automobile
6	.1863	Incident
4	.2964	Events of occupier
7	.1497	Arson
5	.2322	Transportation
1	.6454	Third party
3	.3047	Treatment

Determination of the Mellat insurance company's policies portfolio by Copeland method

The results of various models are in Table 9.

Table 9: Results of the different models

ANP-TOPSIS	AHP-TOPSIS	ANP	AHP	Mmethod / Insurance products
2	2	3	3	Framework of automobile
6	6	5	4	Incident
4	3	6	6	Events of occupier
7	7	2	2	Arson
5	5	1	1	Transportation
1	1	4	5	Third party
3	4	7	7	Treatment

The results of the combined results by Breda method is shown in the table 10.

Table 10: Ranking of insurance products by Breda method

Num of wins	Treat ment	Third party	Transportation	Arson	Events of occupier	Incident	Framework of automobile	Method
3	*M*	*X*	*X*	*X*	*M*	*M*	-	Framework of automobile
0	*X*	*X*	*X*	*X*	*X*	-	*X*	Incident
1	*M*	*X*	*X*	*X*	-	*X*	*X*	Events of occupier
0	*X*	*X*	*X*	-	*X*	*X*	*X*	Arson
2	*X*	*X*	-	*M*	*X*	*M*	*X*	Transportation
4	*M*	-	*X*	*M*	*M*	*M*	*X*	Third party
0	-	*X*	*X*	*X*	*X*	*X*	*X*	Treatment

Thus, respectively, third party, framework of automobile, transportation and events of occupier and Incident insurance, then arson and treatment insurance are placed in Mellat insurance company policies portfolio.

Conclusion

In this study, Mellat insurance company policies portfolio was specified by using the method of multiple criteria decision-making including of AHP, ANP, AHP-TOPSIS and ANP-TOPSIS. The results of the different methods are obtained by combining to Breda and prioritizing the different insurance products. The results showed a higher priority than other insurance is related to third-party insurance. Products of framework of automobile, arson and events of occupier insurances were placed in next priorities. After this products, incident , arson and treatment insurance in the same priority in the portfolio were placed Mellat insurance company policies portfolio.

The third party and events of occupier insurance due to the compulsory have good market potential and one of advantages of these insurances can be pointed to the sale potential of other branches through them. It is recommended more attention to arson insurance in the advertising and sale sites of Mellat insurance company. Due to the fact that the insurance industry in Iran could have contributed to the national income and so far has not reached the status that it deserves, it need to more attention. It needs to effort to introduce unconstrained insurance products and correction the

conditions to increase the attractiveness of these products to people, then stabilize the placement of these products in the consumer basket of people.

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